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THE CREAM SEPARATOR ON WESTERN FARMS.

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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., June 1, 1904.

SIR: I submit herewith a manuscript on The Cream Separator on Western Farms, prepared by Mr. Ed. H. Webster, in cooperation with Mr. C. E. Gray, under the supervision of Maj. Henry E. Alvord, chief of the Dairy Division of this Bureau.

Mr. Webster recently investigated the dairy and creamery business as conducted in Kansas and Nebraska, and reported the results of his work in Bulletin No. 59 of this Bureau, entitled "The Farm Separator: Its Relation to the Creamery and the Creamery Patron." From that report the present bulletin has been prepared by condensation. In order to give it the widest circulation among those who are interested in this line of development, I recommend that it be published as a Farmers' Bulletin.

Respectfully,

D. E. SALMON,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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THE CREAM SEPARATOR ON WESTERN FARMS.

INTRODUCTION.

This subject is treated in this bulletin wholly from the standpoint of Western practice. The section in which observations were made along this line lies almost altogether within the boundaries of Kansas and Nebraska. Not formerly in the list of dairy States, these two have had a history in dairying both unique and interesting. The first lessons in the industry were paid for by the farmers at the rate of about \$100 each in cooperative stock creamery companies, which had been organized by persuasive and persistent promoters. These lessons were well impressed and are remembered even to the present day, although the creamery, with its \$6,000 or \$7,000 investment, has long been used for purposes quite foreign to its original intent. No doubt farther east, where there were more dairymen, investments of this sort made by the farmers turned out better, and such ventures were often successful. West of the Missouri River the farmer was usually not a dairyman, yet when a creamery was to be established in his neighborhood he not infrequently was a subscriber to its stock, although he had not faith or interest enough in it to become a patron and contribute milk or cream until the venture proved a success. This attitude was, of course, obstructive in depriving the new enterprise of patronage at the time most needed. Here and there were exceptions to the usual failures which the first lesson brought. These exceptions served only to prove the rule that, where there were few cows, no experience in the business, and little inclination to become dairymen, a cooperative or a stock-company creamery could not live. The few exceptions were in neighborhoods where the farmers went to milking and stuck to it. These earlier creameries were operated on the "gathered-cream" plan, a method in which every step was ruinous under Western conditions.

Along in the early nineties the skimming station began to make a sweeping change in creamery practice in these Western States. A new impetus was given to the business, and again the farmer was urged to put up his dollars for another lesson. The idea had been conceived of skimming the farmers' milk at a station and shipping the

cream to a central point for churning. This lesson usually cost the farmer about \$25, and the result was much more satisfactory for a time than the first had been. A station was built which the farmers owned, and a creamery was leased. The farmers hauled their milk to the station and hauled their skim milk home. The average distance was not less than 6 miles. One thing that helped the industry at this time was a general period of depression, the cow seeming to be the only thing which would yield an assured income. Although prices of butter were comparatively low, the business boomed. Following this a few prosperous years came and the farmer wearied of the long haul and the small returns he was getting. He hired the hauling done; this ate up the profits. With easy money in other lines of farming and but little profit in the milk business, dairying again had a setback. Skimming stations became expensive to operate because of the small amount of milk handled, and it looked as though many of the small centralizing plants had met their doom. For mutual protection, and with a hope of building up the business again, many of these smaller creameries consolidated, forming large companies.

A few enterprising men had by this time taken up the crusade for the farm separator.^a They were frowned upon by all conservative creamery men. Separator agents multiplied, however, and began to pile up evidence that the farmer could cut off the great expense of hauling milk both ways, and farmers began to buy.

It soon became evident that the farmer was going to have a separator. The conservative creamery man now began to see that, if the farmer bought a separator and was opposed by his creamery in so doing, the cream would go somewhere else. This opened up the whole territory west of the Missouri River, and the creameries, large and small, began to push the farm separator. The separating station dropped out of view almost as suddenly as it had appeared scarcely ten years before. Separator companies could not keep up with their orders. Farmers could hardly wait until a machine could be delivered to them. To be sure, this great demand was not created in a day. The pioneer work for the farm separator was slow and discouraging

^a The machine here referred to is the centrifugal cream separator, or the dairy centrifuge. The invention was brought to this country from Europe about 1879, but was not generally adopted until some years later. The first centrifugal cream separators were hand machines operated by a crank. Then steam power was used, applied by a belt and also directly, as in the operation of turbines. Separators have become commonly known through the use of power machines at creameries and separating stations. The farm separator is the same machine, but of a size and pattern suited to do the work on the farm. Generally it is small and operated by a crank turned by hand. But it may be fitted for use with a dog, bullock, or other animal, or by water, or any power convenient on the farm. Hence, while the farm separator is usually regarded as a hand machine the way in which it is operated is merely a matter of suitability and local economy.—H. E. A.

to those who were carefully fostering its interests. The farmer had already bought a creamery and then a skimming station, and it was almost the "last straw" to ask him to buy a separator. Here and there a machine was sold, and the leaven began to work. To-day the creamery business of Kansas and Nebraska is on the cream-gathering system, and the farmer has the separator in his home. In the more thickly settled portions a few skimming stations still remain, but their days are numbered.

The day of speculation as to the probable trend of the business is past. The farmer now has a separator and the creamery has the product from it. The question is no longer, Will the creamery man sell machines? but, What can the farmer and the buyer of cream do to make their use more profitable to all concerned? This issue must be met intelligently on both sides. The farmer must learn that he has a big part in the final success of the system, and the creamery man must learn that it does not all depend upon the farmer, but that there are things in factory management which he must study and improve.

ADVANTAGES OF THE FARM SEPARATOR TO THE DAIRYMAN.

The reasons for the rapid spread of the farm separator among the dairymen of Kansas and Nebraska have already been suggested. The principal ones will now be enumerated.

RELATIVE COST OF HAULING MILK AND CREAM.

The average distance of hauling over this territory is about 6 miles. Under the old system the cost of hauling the milk both ways, in the farmer's time or in the money he paid for hauling, was a greater tax than the industry would stand. This cost was never less than 10 cents per 100 pounds, and it was often 15 cents or more. This was a direct tax of $2\frac{1}{2}$ to 5 cents per pound on butter fat that was worth but 15 to 20 cents when delivered. No industry could stand this tax and live. This tax on the business furnished one of the leading arguments for separator salesmen, and rightly so. Like most good things, this argument was abused. The farmer was making the trip every day with his milk to the station. It was held out to him that with the separator he could go once or twice a week, or whenever he got a canful of cream. This was an easy argument, and it took well. The farmer did not recognize that cream is a perishable article, and under the most favorable conditions soon becomes unfit as a food product. The creamery men saw the danger, but for the time seemed powerless to act. They accepted it as an inevitable result of the introduction of the farm separator and fought against its introduction. But they were powerless to lower the cost of hauling milk, and had to accept the change.

The change to the home separator proved a means of reducing the cost of hauling, in time or money, to 1 cent or less per pound of butter fat. This difference in cost between the two methods went into the farmer's pocket. The result was an increased interest in the business and greater receipts at the creameries.

BETTER SKIM MILK.

One of the great drawbacks of the old system was the serious loss in the value of the skim milk. The long haul to the station and the long haul home consumed from five to eight hours, and often more. When the cans of skim milk were delivered at the patron's door, the milk was usually in bad condition, and the calves that were forced to drink it were in a worse state. The skim milk was one of the things that never failed to bring out a strong argument against the dairy business. Wise ones often filled the dairy papers with articles about how to feed skim milk to calves successfully, but these wise ones didn't live at the end of a 12-mile route, where they had to feed the article as it was delivered to them, after being from eight to ten hours on the road. It was a common story that skim milk killed the calves and pigs, and was not worth the hauling home. This was probably much overdrawn, for it was very difficult to buy any of this skim milk at the factories. It was not so good as it should have been, but it was needed and recognized as indispensable by every farmer. The introduction of the farm separator, however, wrought a great change. In visiting hundreds of farmers who are using farm separators, the writer has not heard one word of complaint on the score of the skim milk. Calves, pigs, and chickens are greedy for it, and all are doing well on it. Men who would never consider the matter under the old system have been convinced that, with a separator at home, they can raise good calves.

INCREASE IN THE BUTTER FAT.

Many authentic instances are on record where the farmer has sold from one-fourth to one-third more butter fat from the same herd after buying a separator; not that he did not get pay for all butter fat that he delivered to the creamery when he hauled milk, but because he did not deliver all the butter fat to the creamery. The skim milk was coming back from the creamery in condition unfit for the calves. New milk was fed them instead. This happened often, with the result that the calf was eating butter fat worth from 15 to 20 cents per pound when an equal amount of corn-chop worth about 2 cents per pound would have served almost as well. When the farm separator was bought, the calves were weaned earlier from whole milk; in fact, many of them got no whole milk at all. The butter fat was sold. Then,

again, many who hauled their own milk had to quit for a while in the busy season. They could not spare a team to take the milk in. When they bought a separator, the children, with the old family horse and cart, delivered the cream as regularly in these busy seasons as in any other. Under the old system occasionally a can of milk would sour and be returned, and Sunday's milk could hardly ever be kept over. With the separator this never occurred. Thus many farmers were very much surprised to find their monthly checks from one-fourth to one-third larger than they had been before.

There is also less expense, on the whole, attached to the cream system; therefore the farmer secures larger net returns for his butter fat.

When the separator was purchased, the farmer found he could just as well milk a few more cows. He had plenty of cans; he did not have to spend a half day delivering the milk; and, besides, the separator had to be paid for. The result has been an increased number of cows on the farm and a corresponding increase in income per farmer all over the territory under consideration.

THE DANGER OF LOWER-GRADE BUTTER.

There are some serious dangers that may develop unless the farmer studies the situation and follows the instructions given him by his creamery. With the introduction of the farm separator, where everything is so obviously to the advantage of the farmer, he should not forget that the success or failure of the whole enterprise hinges largely on the demand there may be for the product of his separator. If the creameries are forced to turn out a second-grade or third-grade product because of inferior cream, sold by indifferent farmers, the disadvantages to the farmer may become painfully apparent to him. The fact is that, up to the present date of writing, the butter produced from farm separator cream has been inferior in quality to that which was produced in the same territory under the whole-milk system. This has caused much loss to creamery men and will ultimately react on the producer of cream unless he takes some radical steps to better the quality of his product. With this thought in view, the matter of the care of the separator and the cream will be discussed. It is hoped that the farmer will take this matter to heart and seriously consider the question of his future profit in the business and how he can best obtain it.

THE FARM SEPARATOR : ITS CARE AND MANAGEMENT.

Separator companies issue books of instruction with each machine, which are sufficiently clear and comprehensive. These will insure good care of the machine if followed. It sometimes happens that the purchaser thinks he knows more about the machine and how it should

be used than the manufacturer. Such a one generally comes to grief. The farmer never bought a machine before in the use of which he was so frequently and urgently reminded that he must take care of it.

THE MACHINE AND ITS OPERATION.

The principle of operation.—The separator is made for one specific purpose—that of skimming milk. The skimming is done wholly by centrifugal force—that force that makes a ball pull on a string if it is attached to one end and whirled around the hand in a circle. The pull that is exerted through the string, as though the ball were trying to get away, is the centrifugal force. When milk enters the swiftly turning bowl, the centrifugal force, acting on those parts which have the greatest specific gravity, throws them to the outside of the bowl, while the lighter portions—the fat globules—are forced toward the center. In other words, the heavier skim milk is separated from the cream by the action of centrifugal force, instead of the cream being extracted from the milk. Openings on the outer edge of the bowl carry off the skim milk, and an opening near the center carries off the cream. One is discharged below the other and they are caught in different pans or receptacles and thus carried away from the machine.

Internal devices.—The various patterns of separators found on the market have different devices in the bowl for aiding the separation. These are always purely aids. The old style hollow-bowl machine was simply a bowl with a wing soldered to the inside in a line with the axis or central shaft to make the milk revolve with the bowl. There was more or less remixing of cream and milk after it started to separate, and the efficiency was low both as to closeness of skimming and to quantity of work done. Every internal device used in separators has been put there to overcome these difficulties—to keep the milk from remixing, to make it pass through the bowl in a steady flow, and to divide it up in such ways that a greater quantity of milk can be passed through the bowl and receive the action of the separating force. The steady, even flow secured by these devices is also obtained or helped by a perfectly steady and uniform motion of the bowl.

Handling and care of machine.—If the machine shakes while it is skimming there will be some intermixing of the milk and cream and the result is poor skimming. The operator should aim to secure two things if he expects his machine to do good work: (1) A perfectly true motion of bowl; and (2) a sufficient speed (which must be uniform) to create force for separating.

In order to have the perfect motion of the bowl, the machine must be set level and be kept clean and well oiled. The oil should be thin, or light, so that it will not gum the wearing parts. A heavy oil will make the machine run hard and will gum quickly on small high-speed

bearings. All the bearings of the machine should be frequently flushed with coal oil. It is well to make a run about once in two or three weeks, using coal oil on all the bearings. This keeps the parts free from gum and washes out grit or sand that may have blown into them. It is an excellent plan to have a cover of close-woven cloth or oilcloth, that can be kept over the machine while it is not in operation. This will keep out dust and sand and will add materially to the lasting powers of the machine. The separator should be set up on a good solid floor, so that it will not move or sway about as the operator turns the crank.

Life of the machine.—The life of a separator depends mainly upon the factors just pointed out. A machine that is allowed to run gummy or dirty may wear out in a year. If kept free from dirt and well oiled it will last a number of years. One of the objections urged against the separator was that it would not be properly handled and that one or two years' service would wear the machine out. After visiting several hundred farms and inspecting as many machines, the writer has concluded that the farmers, as a whole, are taking much better care of their separators, mechanically, than was anticipated. Machines have been found that had seen several years' service and were still practically as good as new. In a few instances careless operators had nearly worn a machine out in less than twelve months.

Speed of machine.—Uniform centrifugal force is obtained by turning the crank at a given speed at all times and giving the crank an equal pressure at all points in its circuit. All machines have marked upon them, or given in the instruction book, the number of revolutions the crank should make per minute. Follow these instructions, counting the revolutions each time the machine is operated and frequently during operation, to be sure the speed is maintained. This is a point in which much careless work is done. Too many guess at the speed, and they seldom guess right. It is a good rule never to guess at anything when it is possible to know. The writer has found variations all the way from 25 to 75 revolutions per minute in the operation of machines by guess. At neither of these extremes would the operator believe that he was wrong until he had been made to count the number of revolutions by the watch.

The greater the speed the greater the centrifugal force, and thus the greater the efficiency in separation. The speed at which a machine should be run is indicated by the manufacturer. Never run slower than this; it is not practicable to run faster. If the machine is run at low speed, the separation will not be complete and the cream will be thin. The incomplete separation means a loss of butter fat left in the skim milk. This loss should be avoided, and it can be by running at the required speed. Count the turns of the crank by the watch.

QUANTITY OF MILK FLOWING THROUGH THE BOWL.

In most machines this flow is fixed by the size of the opening and the height of the supply can; in some it is not. Within certain limits the amount which passes through the bowl has a decided effect upon the separation. The faster the milk passes through, the shorter the period in which the centrifugal force acts on it and the less complete is the separation. If the amount of milk be turned off about one-half, by partially closing the faucet over the bowl, the cream will be thicker. It may become so thick that it will not flow from the machine. If the float should be removed and the pan be allowed to run full of milk, without any other change of condition, the cream would be very thin. In this, as in change of speed, the quality of the skimming is affected. The greater the supply of milk, the less perfect the skimming; on the other hand, if the supply should become so small that the cream would not flow from the machine, all of the milk would pass out through the skim-milk tubes.

TEMPERATURE OF THE MILK.

The warmer the milk the more fluid it is. It is a rule adopted by all creamery men in operating power machines that the milk must be separated at a temperature above 85° F. Cold milk is more viscous, or less fluid, than warm, and the cream will not separate so readily. If this is true of power machines, where everything runs more uniformly than is possible with a hand machine, it is certainly true of the hand machine. It is one of the stock arguments of some separator agents that their machines will skim cold milk. Probably the statement is true. If so, it shows a wide range of adaptability for the machine and that it is so built that it is difficult to clog up. Take the argument for what it is worth, but do not skim cold milk unless you expect to leave some butter fat in the skim milk. The milk should be separated as quickly as possible after milking; then the skimming will be cleanest, the skim milk will be best for the calves, and the cream will keep better.

USE OF THE CREAM SCREW.

One of the questions most frequently asked is, "Why does my test vary so?" The reasons have nearly all been given in the foregoing paragraphs. The test varies with the speed of the machine, with the amount of milk run through the machine, and with the temperature of the milk. Every machine has some device for changing the test of the cream when these factors remain constant. It is done by an adjustable outlet either for cream or skim milk. In most cases the adjustment is in the cream outlet. Directions for adjusting the cream screw are given in the books of instruction that go with the machines.

There are some factors of separation not mentioned above which influence the percentage of fat in the cream. These factors are usually overcome by proper adjustment of the cream screw. In the summer, when the cows, on green succulent pasture, are at their best and giving large quantities of milk, the milk is easy to skim. The reverse is true in winter if the cows are wholly on dry feed. It is usually the case that milk tests higher in butter fat in winter than in summer if most of the cows calved in the spring. As a rule, rich milk will give the richest cream, other things being equal. It will give no more butter fat than is contained in the milk, but the cream will be richer in butter fat. Though the proportion of milk to cream may remain about the same, the cream will test richer in fat. It thus happens that in winter the cream screw has to be set so that it will make a larger quantity of cream from a given amount of milk than is customary or necessary in summer. The cream screw enables the operator to make allowance for changes of season and character of milk in order that a uniform cream may be obtained under all conditions, if so desired.

THE SANITARY CONDITION OF THE MACHINE.

If the mechanical care of a machine is important as affecting its durability, the sanitary care of the machine is doubly so as affecting the purity of the product which passes through it. Milk—one of the best and purest of human foods—is one of the quickest to become unfit for food if it is not kept clean and handled in clean vessels. While the purchaser of a separator has been again and again impressed with the idea that it must be kept in perfect order, the same agent has told him that the parts which come in contact with the milk did not need to be washed oftener than once a day and that the cream could be delivered once a week! It is right here that the advantage of the hand separator to the farmer may turn to naught unless cleanliness, which is so essential to purity of product and to profit in the business, is thoroughly impressed upon the user. It is not enough to rinse the machine out with a little warm water and let it stand until next time, for the slime and solid particles of unclean matter in the milk that are caught and held in the bowl are at just the right temperature to decay, and an evil smell soon develops. The machine must be well washed after every separation of milk.

There are some things about washing vessels which come in contact with milk that the average housewife needs to learn. The dishcloth as found in the average kitchen should never be used on dairy utensils. It is the exception where one will be found to smell sweet an hour after it has been used; and yet milk utensils are often washed with it and wiped with a towel that has done duty on all of the china and glassware of the household, and possibly the pots

and kettles, before the tinware of the separator is touched. Discard the dishcloth and the dish towel while the milk utensils are being washed. Wash them in warm water first, with plenty of some washing compound, and use a brush to do the work, but never a rag. Get into every part of them, after which rinse off with clean warm water, and then either put them in boiling water or pour boiling water over them. Stand the parts up so that they will drain, and use no cloth to wipe them. The hot surface will dry them quickly, and they will be clean. Leave the parts in a sunshiny place if possible. This may seem to be putting too much stress on the case, but evidence gathered in the field shows the need of some vigorous words along this line. The outside of the frame, which does not come in direct contact with the milk, also needs scrupulous care. Cases have been noted where the color of the machine could scarcely be distinguished because of the grease and dirt or dried milk covering the paint. Pure cream could hardly be expected to come from such a place. It is pleasant to know that at more than three-fourths of the farms visited the separators were well kept and the people were trying to do the best they knew how. There was, however, a great lack of knowledge.

MANAGEMENT OF CREAM ON THE FARM.

The dairy industry of Kansas and Nebraska is comparatively new. It is not the main business of the farmers, but rather a side issue, forced upon them by adverse conditions or aggressive creamery agents. The farmer of this section has never given serious attention to the careful handling of his cream. He has the cows and the separator, and the market that takes his cream asks but little of him in the way of quality. Naturally but little has been done to keep the product pure from the time the cow is milked. Now, however, times are changing rapidly in this respect. The creameries are requiring quality tests to be made of the patron's cream and are paying for it on that basis. This is going to bring the farmer face to face with a new proposition. He must learn how to care for his cream in such a way that he may deliver it to the creamery in perfect condition.

CLEANLY MILKING.

The milking is the starting point of most of the trouble with cream. The milker sits down with a pail, open at the top, and begins to milk. Any dust, straw, or manure that may be hanging to the udder is gradually dislodged and finds its way into the milk pail. Every particle of such dirt carries with it a quota of germ life, which consists of minute plants or bacteria, so small that they can not be seen without the aid of a microscope. The function of this plant growth is to

cause decay. All decay is brought about by the action of bacteria. Germ life requires certain things to promote growth, just the same as does corn, wheat, or any other plant with which the farmer is familiar. The corn requires food, moisture, and warmth to make it grow and thrive. These must be furnished at the right time and in the right form or the corn does not thrive. It is just so with germ life. In order to grow, the germs require proper food, warmth, and moisture. All of the conditions which best promote the growth of these minute, invisible plants are found in warm milk as it is drawn from the udder. Thus while the dairyman milks he unconsciously plants; he plants the seed of destruction in the very product he is going to market. The destruction begins at once and is carried on very rapidly so long as the proper temperatures are maintained.

The remedy would naturally suggest itself. Stop the dirt from getting into the milk. This can be done easily and quickly. If the milker will carry with him a damp cloth, and carefully wipe off the udder and the parts immediately around it, the trouble will to a great extent be prevented. All of the coarser particles of dirt will be rubbed off and the finer particles of dust dampened, so that they will not fall into the pail. This work will require but a few moments of extra time and prevent much after trouble in the way of sour and ill-flavored cream. The cow should be milked in a place in which the air is free from dust. In the winter, or when the cows are kept in the stable, never feed, or move hay, or clean out the place, or do anything to stir up dust or strong smells just before milking.

SEPARATING THE CREAM.

The cream should be separated at once after milking, while the milk still has the animal heat in it. The work of the day should be so arranged that this can be done. Do not use a cloth strainer. The separator will remove all the solid dirt that may be in the milk much better than it can be done with a strainer. There never was a cloth strainer used that would not in a few days become yellow and smell bad. Under the best conditions, where steam can be used to help in cleansing, the cloth strainer is a source of danger rather than a benefit. A well-made wire strainer might be used, but there is no need of any strainer. Pour the fresh, warm milk directly into the supply can and send it through as quickly as possible.

COOLING THE CREAM.

At once on finishing the separating, begin the cooling of the cream. The calves can wait a few minutes better than can the cream. There are devices made for cooling the cream as fast as it comes from the separator. These are good and can be made of much service if kept clean,

but they add to the number of utensils that have to be washed and, like the strainer, they may be dispensed with. The dairyman should provide himself with enough cans, made after the old-style "Cooley" or "shotgun" pattern, to hold the cream. A can of this kind holds from 3 to 5 gallons, is about 20 inches deep and 9 inches in diameter. These cans are the best to keep the cream in at the farm. They are convenient to use and keep clean, and they present a large cooling surface, which is a great advantage in cooling cream. Set the pail or pails of cream in a tank of cold water and stir, testing the temperature with a thermometer until the cream is as cold as the water. This is imperative if success is to be obtained. As with the wiping of the cows' udders, this is a matter of a few extra minutes, but it will be a factor in deciding success or failure. The stirring rod and the thermometer should be considered as indispensable as the crank on the separator, and yet hardly one in five hundred farmers of the West has a thermometer that can be used for this purpose. If the can of cream is set in a tank of water and left without stirring, it will be hours before it becomes thoroughly cool. In the meantime the germs which have gotten into it in spite of the greatest of care have been multiplying at a tremendous rate and the cream goes to the station spoiled. At the temperature of ordinary well water the development of the germs is very slow, and for this reason no time should be lost in cooling the cream to this temperature. The thermometer is absolutely the only means by which one can tell whether the cream is fully cooled or not. By stirring and testing with the thermometer the task of cooling will be found to be short, and one will finish with the satisfaction of knowing that the cream is cool. It ought to be cooled down to 60° F., and if the water is cold enough to carry the cream lower so much the better.

HOLDING THE CREAM.

Generally speaking, there is almost an entire lack of facilities for holding cream on the western farm. The majority of farms have wind pumps at or near the house. The pump furnishes an excellent location for an ideal milk house. On many farms visited the owner had built around the windmill tower, or at one side of it, a building, usually 6 by 8 feet, in which was placed a tank deep enough to set the milk cans and have water come up to their necks. All of the water pumped for stock and other purposes of the farm is run through this tank and then out into the stock tank. This room often contains the separator and a work table; in fact, here is done the dairy work of the farm. With an arrangement of this kind the cream should be kept without difficulty from forty-eight to seventy-two hours in the hottest weather. Such a building costs but little, and the convenience of having a place for the milk, cream, and dairy utensils is in itself enough to justify the expense of building it. As a matter of fact, the farmer

who is going to get the best price for his cream will have to provide himself with a place to keep it cool until it can be delivered to the station. Keep it just as cool as is possible, without freezing, up to the time it is delivered.

There are some points besides the immediate cooling and holding at a cool temperature that must be observed in order to insure good cream. The different skimmings of cream should never be mixed until both are of the same temperature. The cream when cooled down keeps fairly well, but if some warm cream should be mixed with it the temperature will be raised. At once the germ life becomes more active, and souring takes place very quickly. It would be well to have cans enough and of different sizes to keep the different skimmings separate until delivery. No vegetables or other produce having strong odors should be kept in the same room with the cream; it takes such odors very readily and retains them tenaciously. In fact, keep the milk room for milk and nothing else, and, above all, have plenty of windows to admit sunshine when wanted, and use plenty of "elbow grease" in keeping it sweet and clean.

DELIVERING THE CREAM.

In many instances all the good work done is entirely spoiled because the cream is not cared for in delivery. The writer has observed many thousand cans in process of delivery, and nearly 99 per cent of them were handled in such a manner as to damage the cream. For some reason, probably through lack of better information on the part of the person delivering the cream and also on the part of the man receiving it, the cream was handled as though no damage could come to it after it was taken away from the farm. It mattered not whether the heat of the summer's sun or the cold blast of the winter's storm was on, the can of cream was exposed to it all. Withdraw the lid of a can of cream that has been exposed to the heat for one or more hours and the first whiff is a sour one. The cream will be found to be several degrees warmer than when taken from the water tank at the farm. This warming has the same result as mixing warm cream with cold. The germ life is made active and the souring process goes on with greater rapidity than before. It is a simple thing to cover the cream can with a wet sack or blanket and throw over this a dry one, which will effectually stop the mischief. With this precaution the cream will arrive at the station as cool as when taken from the farm. Why this should be so commonly neglected is almost beyond comprehension, but it is the most universal of all wrong things done by the farmer in the production of pure cream. The same precaution, except that the blanket should be dry, is a sure protection against freezing in winter. Creamery men should insist that cream be delivered properly, to avoid the loss which occurs constantly through carelessness of this kind.

FREQUENCY OF DELIVERY.

It is a safe proposition to say that in 95 cases out of 100 the cream is not delivered oftener than three times per week in summer and twice a week in winter. There are many reasons for this. The distance of hauling is not less than 6 miles on the average, and it is a question whether the patron can afford to make the trip more than three times per week. Some of the larger creameries receive cream but three times per week and others four times, while a number keep their stations open every day except Sundays. From 80 to 90 per cent of the patrons of stations that are open every day do not deliver oftener than three or four times per week. There is a tendency in some quarters to urge farmers to more frequent delivery and in others to insist on better care of the cream between deliveries. The creameries which operate their stations but three times per week are forced to the latter alternative.

The question of delivery should not be placed upon a par with that of keeping cream at the farm; or, in other words, there is an important difference that should be noted on the part of both the creamery and the patron. The cost of keeping milk and cream at the farm is practically paid when the equipment is put in to properly handle it. This equipment need not be renewed for years if it is properly cared for. The time required to put the cream in shape for keeping, over that spent by the dairyman who neglects this part, is very small. On the other hand the hauling takes time for every delivery and the cost is always that much more for each delivery made. The investment is never completed, but has to be worked out as time goes on. If it can be shown that cream can be kept forty-eight, sixty, or even seventy-two hours, and delivered in good shape every second or third day without any expense other than a few minutes of attention each day and one original investment in a windmill, pump, milk-house, and tank, the farmer would not be justified in making six trips per week where three would do the work, thus doubling the cost of delivery. It is worth while for the farmer to study this question and secure the proper equipment for handling the cream on the farm. Under the ordinary practice now in vogue, with imperfect facilities at hand, the cream is not sweet when delivered, in 90 per cent of the cases, if it is more than twenty-four hours old. This is not because it can not be done, but, as pointed out in the preceding paragraphs, because proper care is not taken before the time of delivery. Let the instructions of the preceding paragraphs be followed, and then the cream can be delivered three times per week in sweet condition.^a

^aThe plan of carrying cream from the farm to the shipping station only once in two or three days may do for the peculiar conditions existing in the region specially under consideration—the formative stage of dairying recently introduced in a new

HANDLING CREAM THROUGH A STORE.

Reliance upon stores and storekeepers to get cream from the farm to the churning place is a drawback to the creamery business. There is nothing to commend this plan. The storekeeper has not the time, and is rarely equipped with facilities for doing the business properly. He buys cream from the farmers to get trade, and is at their mercy because he has to take it, be it good or bad, or lose a customer. Cream being of a perishable nature, he can not handle it as he does potatoes or apples. If he uses the cream business as a means of advertising, he is apt to run the price of butter fat up to a fictitious value, thus creating a false impression of the business. With the cream-receiving station as a competitor, this method of handling cream will be short lived.

THE DIRECT SHIPPER.

The direct shipper is one who takes his cream to the railroad station and ships directly to the central factory or creamery as often as possible. He must hold his cream until he has a full can—5, 8, or 10 gallons; otherwise the expense of shipping is such as to greatly reduce the net receipts for the cream. The larger number of this class will not average over two shipments per week. The man who milks a large number of cows, and can ship a can every day, or every two days at most, may furnish his creamery with as good cream as anyone, but there are few of this kind of shippers in the West.

The creamery run on this plan seldom adds anything materially to the development of the dairy business, unless it be in new territory. It can dip in here and there and get quite a patronage from disgruntled individuals who are dissatisfied with their home creamery and will go anywhere for a change. It is not meant to speak disparagingly of anyone in the direct shipping business, but these statements are made because observations over two great dairy States show it to be a fact that the greater part of the patronage of this kind of factory is of this class. The quality of such cream during the hot weather—and this is about seven months of the year—is bound to be inferior to that handled through stations. The author can suggest no

country—but it can not be recommended to creamery patrons generally as a good plan. For best results there is no doubt that cream should be sent from the farm to the churn with the least possible delay. Daily delivery and shipment of cream should be the aim. How this is to be accomplished, especially where quantities are small, on scattered farms, is a question which must be worked out by local conditions. It may be done by cooperative effort among farmers, by a carrier paid by them, by a gatherer employed by the creamery, or in some other way. The matter should not be considered as settled right, however, by the owner of the cows or the buyer of the cream, until deliveries of cream at the creamery or the shipping station are as frequent and as regular throughout the year as were the former deliveries of milk.—H. E. A.

remedy for this unless it be to ship oftener, which is a financial impossibility in the working of the system. During the winter months the direct shipper is on a more nearly equal footing. There is a time in the development of a new territory when the business can be conducted by direct shipping methods. This is when the patronage is too small to justify the operation of a cream-receiving station. In such instances—and there are a good many where the dairy business is extending into new territory—there is nothing to be said against the system so long as it remains in that stage of development. This does not imply that good cream can be so secured, but it means giving a market to those who would not have one in any other way. As soon as such territory is sufficiently developed the station system will give the best results to both farmer and creamery.

THE CREAM-SHIPPING STATION.

The approved and most successful present practice is for the creamery company having a well-located central manufacturing plant to establish stations, usually on railway lines, at which cream is received from the producing farmers and shipped daily to the factory. Every station is in charge of an agent of the creamery competent to sample and test the cream and keep accounts with the patrons. The work of the latter is simplified, because the station operator is able to receive cream whenever it may be delivered, and in any quantity, and to properly care for it until shipped.

RESULTS OF INVESTIGATIONS MADE IN KANSAS.

Several weeks were spent at Colby, Kans., studying the question of quality and what could be done to improve it on the part of the farmer and the creamery management.

Examinations were made of the cream received from the patrons, and experiments were made with the cream shipped from the receiving station to the central factory at Topeka. Upon arrival at the factory the same cream was again examined for comparison with the record at the point of shipment.

CONDITION OF CREAM RECEIVED FROM PATRONS.

Examinations were made from July 20 to August 1, a time when the farmers were in the midst of one of the greatest wheat harvests ever known in western Kansas and Nebraska, the weather was the hottest of the summer, and altogether the conditions for getting a good quality of cream were as unfavorable as they could be. An acid test^a was made of every can of the cream received and notes on the general

^a The acid in milk or cream is measured by using an alkali solution of a certain strength with an indicator which shows, by a change of color in the milk, when all its acid has been neutralized. A one-tenth normal solution of caustic soda is the

quality were taken. It was found that the acid test was the best indication of the general quality of the cream. Cream that was delivered sweet was in nearly every case of fine flavor, while that delivered sour was often of very poor flavor. Cream having an acid measure above 14 was classed as sour. In scoring the cream as many points were allowed as would be expected to be given to the butter made therefrom. For convenience of discussion, the different milkings from which cream was separated before delivery were numbered as follows:

The milking of the morning on which delivery was made was No. 1; the milking of the evening just previous to this was No. 2; the milking of the morning before the day of delivery was No. 3; that of the evening before this, No. 4, etc.

Taking the results of all tests known to represent milkings No. 1 or Nos. 1 and 2 mixed, the average degree or measure of acidity was 9.3 for 226 such lots. Taking the cans that might contain Nos. 1, 2, 3, and 4, or Nos. 2, 3, and 4, or Nos. 3 and 4, the average acidity was 22.1 for 260 such lots. Taking the cans supposed to contain milkings Nos. 3, 4, 5, and 6, or Nos. 4, 5, and 6, or Nos. 5 and 6, the average acidity was 29.5 for 25 such lots. Of the first class mentioned only 33 out of 226 cans contained enough acid to justify classing them as sour cream—that is, 14 or above. In the second class the acid measure was less than 14 in only 33 out of 260 cans, and these only were classed as sweet cream. In the third class all were sour. These facts are tabulated as follows:

Condition of cream when delivered by patrons.

Class.	Number of cans.	Sour.	Sweet.	Average acidity.
1	226	33	193	9.3
2	260	227	33	22.1
3	25	25	0	29.5
Total	511	285	226	.....

Mondays showed the most sour cream and Saturdays the most sweet cream. Of the total receipts for each week, the sweet cream averaged

alkali solution used most frequently. In Mann's test 50 cubic centimeters of cream is measured out into a clean porcelain or glass cup, a few drops of the indicator (phenolphthalein solution) are added and the alkali solution is cautiously dropped in from a burette. By constant stirring during the operation it will be noticed that the pink color formed by the addition of a drop of alkali solution will at first entirely disappear, but as more and more of the acid in the sample becomes neutralized, the color will disappear more slowly, until finally a point is reached when the pink color remains permanent for a time. The measure of acid in the sample is represented by the numeral showing the number of cubic centimeters of alkali solution used. Such numerals thus indicate the relative acidity of different lots of cream; the larger the number the more acid the cream. Alkaline tablets can also be used. These are dissolved in water and the process carried out as with the Mann test, with the exception that the indicator is already in the tablet solution.

about 33½ per cent. It was noted that the temperature had considerable influence on the acidity of the cream, much more sour cream being received on warm days than when the weather was cooler. The patrons who had a place fixed for holding cream so that they could cool it quickly and hold it cool until delivered had sweet cream when they delivered it every other day. The average well-water temperature of this vicinity was about 60° F., and cream held at this temperature was delivered sweet forty-eight hours old. What these few did every man could have done, for all had the same natural conditions of sunshine and shade and wind and water.

EXPERIMENTS IN SHIPPING CREAM.

Experiments were carried on cooperatively between the shipping station at Colby, Kans., and the creamery at Topeka. Cream was received and graded at the station, part of it being pasteurized and part shipped raw. The acidity and temperature was determined on each sample at the station and again when it arrived at the factory. The following table gives a summary of the results obtained:

Averages of data of cream-shipping experiments, August, 1903.

Number of cans.	Kind of cream.	Dates.	Time on road.	Station temperature.	Factory temperature.	Station acidity.	Factory acidity	Station grade.	Factory grade.
		<i>August.</i>	<i>Hours.</i>	<i>°F.</i>	<i>°F.</i>				
53	Pasteurized ..	17-28	23-26	64-88	64-80	10.2	16.1	95.97	91.96
19	.....do	17-22	42-48	68-86	68-75	12.2	30.8	95.16	88.76
18	.....do	26-28	24	64-76	64-70	9.9	10.5	96.00	93.08
45	Raw	17-31	22-26	64-80	64-78	21.0	33.8	93.96	89.96
31	.....do	17-22	42-48	66-82	68-76	26.5	38.5	92.02	86.88
17	.....do	29-31	22-24	66-70	64	14.0	31.1	94.72	89.68

Cream testing an average of 10.2 of acidity when pasteurized was found on arrival at destination twenty-four hours later to have increased in acidity 5.9, so as to measure 16.1. Cream at this acidity is slightly sour. Comparing this with the cream that was two days in transit, quite a difference will be noted. This cream started under conditions practically equal to those of the cream which was one day in transit. The station acidity was 12.2, and on arrival at the factory forty-eight hours later it had increased 18.6 or to 30.8. The difference between the acidity after being one day in transit and the acidity after being two days in transit is simply the result of time in developing the acid.

The average for the cream shipped on August 26, 27, and 28 is interesting. An acidity of 9.9 at the station advanced only to 10.5 at the factory twenty-four hours later, with scores of 96 at the station and 93.08 at the factory. These lots were similar to those of preceding days, with the exception that the cans used in shipping were washed out with very strong lye water after the regular washing was given

them and then rinsed with cold water before filling. The cans in the previous lots were washed with a common washing compound, and the work was not very well done. The cream was much more uniform on arrival at the factory than any of that shipped on preceding days.

Raw sour cream, with an acidity of 21 when shipped, on arrival at destination, twenty-four hours later, had increased to 33.8, or an increase of 12.8. The average score at the station was 93.96, while at the factory it was 89.96. Contrasting this with cream that was two days in transit, the difference is not found very marked, at least not so much so as in the case of the pasteurized cream.

The average of raw cream shipped on August 29 and 31 is here as interesting as in the case of pasteurized cream. This cream left the station with an average of acidity of 14, and arrived at the factory twenty-four hours later with an acidity of 31.1, the average score falling from 94.72 to 89.68. The same precautions in regard to cans were used in this case as on August 26, 27, and 28, with the pasteurized cream.

In conducting the above experiments one of the hardest things to overcome was the foul smell in the shipping cans. All ordinary means of washing seemed to fail in eradicating these odors, and cream from the same lot placed in different cans at the station would reach the factory in various stages of fermentation and presenting a variety of odors. It was not until the cans were rendered practically sterile by washing in strong concentrated-lye water that the difficulty was overcome. For the best results in pasteurizing, the cream should be delivered by the farmer in a perfectly sweet condition.

THE CREAMERY'S RESPONSIBILITY.

Up to January 1, 1904, in the area covered by the writer's investigations, all cream received from patrons brought the same price, no matter what its condition. The patron who took pains to furnish good cream saw it dumped into the same vessel with other cream that he knew was of inferior quality. This object lesson at the stations and the system of buying cream were all against quality, and yet the creamery man who did not lay all of his troubles on the farmer was the exception. The creamery companies were doing what they thought was best to get good cream from their patrons, but yet failed to do the part that was in their own hands. Let the farmer take home all the blame due him, but let the creamery operator learn that poor butter has often resulted from his lack of facilities and knowledge of how best to handle the cream when it came into his care.

The past few months have shown some great advancement on the part of the creameries in this respect. The whole subject is studied as never before. New ideas are put into practice, and new methods

are used in the factories. Much of this is in the experimental stage as yet, and needs time to develop its worth. From some quarters have come remarks deprecating any effort on the part of the creamery to improve the quality of the cream after it has once deteriorated in value. Theoretically this may be all right; the cream ought not to need improving, but the creamery that tries to improve the quality will find its own shortcomings more quickly, and will learn that the farmer should not bear all the blame. Let the effort to improve all along the line go on; there is surely great need for it.

CREAM GRADING.

This subject is so new that no practical results from it can yet be given. The system of fixing different grades of cream, according to condition and quality of butter, and paying different prices for these grades, is not a new one, but there have been objections raised which have prevented its earlier adoption. Such a system has now been adopted by one large Western creamery company, and others will soon follow this example. This places a premium in the form of highest price for cream of best quality, which results from intelligent management on the farm, care of the cream, and its frequent delivery in best condition. A considerable number of producers are already in position to reap the benefits of this system, and the extra cent or two on every pound of fat which the careful farmer gets will surely be an incentive to others who will learn how their neighbor does it, copy his methods, and get their cream also admitted on its merits to a higher grade.

In order to create these different grades of cream, one or more dividing lines had to be established. The degree of acidity in the cream is the first basis for division. The cream receivers or station operators are taught to measure the acidity by the Mann acid test (see footnote on page 18), and this is a simpler matter than measuring the fat in the cream by the Babcock test. It is probable that the senses of taste and smell can be depended upon to determine the acidity after a little practice, so that the patron or cream owner and the creamery station operator will be likely to agree on the grade in most cases without resorting to the Mann test.

In beginning this system the Western creamery company already mentioned established only two grades, with a difference of 1 cent in the price of a pound of butter fat in the two grades. Detailed instructions in print were sent out to station operators and the plan went into effect January 1, 1904.

It is not thought that this system of grading will cure all the ills of the creamery business, but it will go a long way toward establishing a line of demarcation between good and bad cream. It is, perhaps, only the

first step of what will ultimately be considered the right thing in grading cream. If creamery men and patrons alike will look upon this as a means to an end—namely, that of improving the quality of cream from farm separators until the greater part of the cream delivered will make high-grade butter—this scheme of grading and the work leading up to it will not have been in vain. There is no fear of the ultimate outcome of the farm-separator system if all who are concerned in it make the best use of the means they have at hand and study to know more about the business and to make high quality of both cream and butter—the end to which all efforts should be bent.

FARMERS' BULLETINS.

The following is a list of the Farmers' Bulletins available for distribution, showing the number, title, and size in pages of each. Copies will be sent free to any address in the United States on application to a Senator, Representative, or Delegate in Congress, or to the Secretary of Agriculture, Washington, D. C. Applications from residents in foreign countries should be sent to Superintendent of Documents, Government Printing Office, Washington, D. D.; price per copy 6 cents, including postage. Numbers omitted have been discontinued, being superseded by later bulletins.

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